

PATENT

PATENT

of

for

MAGNETIC SLEEVE ASSEMBLY

Station	Time	Lat	Long	Alt	Temp	Wind	Dir	Speed	Pressure	Humidity	Clouds	Remarks
10000	1000	10° 00' N	100° 00' W	1000	10.0	10	100	10	10.0	100	100	100
10001	1001	10° 01' N	100° 01' W	1001	10.1	11	101	11	10.1	101	101	101
10002	1002	10° 02' N	100° 02' W	1002	10.2	12	102	12	10.2	102	102	102
10003	1003	10° 03' N	100° 03' W	1003	10.3	13	103	13	10.3	103	103	103
10004	1004	10° 04' N	100° 04' W	1004	10.4	14	104	14	10.4	104	104	104
10005	1005	10° 05' N	100° 05' W	1005	10.5	15	105	15	10.5	105	105	105
10006	1006	10° 06' N	100° 06' W	1006	10.6	16	106	16	10.6	106	106	106
10007	1007	10° 07' N	100° 07' W	1007	10.7	17	107	17	10.7	107	107	107
10008	1008	10° 08' N	100° 08' W	1008	10.8	18	108	18	10.8	108	108	108
10009	1009	10° 09' N	100° 09' W	1009	10.9	19	109	19	10.9	109	109	109
10010	1010	10° 10' N	100° 10' W	1010	11.0	20	110	20	11.0	110	110	110
10011	1011	10° 11' N	100° 11' W	1011	11.1	21	111	21	11.1	111	111	111
10012	1012	10° 12' N	100° 12' W	1012	11.2	22	112	22	11.2	112	112	112
10013	1013	10° 13' N	100° 13' W	1013	11.3	23	113	23	11.3	113	113	113
10014	1014	10° 14' N	100° 14' W	1014	11.4	24	114	24	11.4	114	114	114
10015	1015	10° 15' N	100° 15' W	1015	11.5	25	115	25	11.5	115	115	115
10016	1016	10° 16' N	100° 16' W	1016	11.6	26	116	26	11.6	116	116	116
10017	1017	10° 17' N	100° 17' W	1017	11.7	27	117	27	11.7	117	117	117
10018	1018	10° 18' N	100° 18' W	1018	11.8	28	118	28	11.8	118	118	118
10019	1019	10° 19' N	100° 19' W	1019	11.9	29	119	29	11.9	119	119	119
10020	1020	10° 20' N	100° 20' W	1020	12.0	30	120	30	12.0	120	120	120

TITLE OF THE INVENTION

Magnetic Sleeve Assembly

CROSS REFERENCE TO RELATED APPLICATIONS

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Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED

RESEARCH OR DEVELOPMENT

Not Applicable

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BACKGROUND OF THE INVENTION

Field of the Invention - This invention is in the field of linear electromechanical transducers, motors, or alternators, particularly as might be used in a linear refrigerant compressor motor.

15 Background Art - In the field of electromechanical alternators and motors, the generation of a time changing magnetic field in the vicinity of an electrical conductor can induce a voltage in the conductor, resulting in the flow of electrical current. Similarly, passing a time changing electrical current through an electrical conductor generates a time changing magnetic field, and this time changing magnetic field can be used to create mechanical motion. This principle is used to build motors for various uses, including
20 motors used to drive refrigeration compressors.

In some refrigeration compressors, such as those used in cryogenic compressors, it can be beneficial to use a linear motor built on this principle. A cylindrical support sleeve can have a plurality of magnets mounted thereon, to create a magnetic assembly. This
25 magnetic assembly can be mounted for linear translational, reciprocating, motion. Generation of a time changing electrical field imposes a time changing magnetic field on this magnetic assembly, causing it to reciprocate. The magnetic assembly can be attached to a compressor, to drive the compressor and compress the cryogenic refrigerant.

Known devices which utilize these design principles typically attach the magnets
30 to the cylindrical support sleeve by the use of an adhesive. The adhesives used for this

purpose may outgas in certain environments. Unfortunately, in some such compressors, this outgassing of the adhesive may introduce undesirable impurities into the flowpath of the cryogenic refrigerant. This can result in the plugging of small passages in the refrigerant flowpath, especially in miniature cryogenic systems, such as those used in some medical catheter systems.

BRIEF SUMMARY OF THE INVENTION

The present invention includes a slotted cylindrical support sleeve to which are attached a plurality of magnets. Preferably, no adhesive is used in this magnetic assembly. The magnets may be attached to the support sleeve by circumferential support brackets which are in continuous contact with beveled bearing surfaces on the magnets. The support brackets may have angled lips which extend over and contact, along a line of contact, the beveled bearing surfaces on the magnets. As the magnets and the support sleeve expand and contract, the lips move up or down the beveled bearing surfaces on the magnets, maintaining continuous contact and continually forcing the magnets against the support sleeve.

Since, in certain embodiments, no adhesives are used, there is no harmful outgassing. Since, in certain embodiments, there are no spaces, or minimal spaces, between the support brackets and the magnets, the assembly is less prone to becoming loose.

The novel features of this invention, as well as the invention itself, will be best understood from the attached drawings, taken along with the following description, in which similar reference characters refer to similar parts, and in which:

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1 is a perspective view of a magnetic sleeve assembly according to the present invention;

Figure 2 is a perspective view of the magnetic sleeve assembly shown in Figure 1, from the opposite perspective;

between the two mounting rings 22 and holds the magnets 16 firmly against the support sleeve 12. Instead of the continuous mounting rings 22 shown, segmented mounting rings or brackets (not shown) could be used.

As shown in greater detail in Figure 6, each end of each magnet 16 preferably has
5 an annular beveled bearing surface 24 which faces generally radially outwardly from the support sleeve 12. The beveled bearing surfaces 24 on the ends of the magnets 16 are generally in annular alignment with each other. The mounting ring 22 has a base 25, which is mounted directly to the external peripheral surface of the support sleeve 12. The mounting ring 22 also has an angled lip 26 extending over the ends of the magnets 16,
10 and contacting the beveled bearing surfaces 24 on the ends of the magnets 16. Upon installation, the angled lip 26 can flex slightly because of forcible contact with the magnet 16. Contact between the angled lip 26 of the mounting ring 22 and the beveled bearing surface 24 of the magnet 16 is along a single annular line of contact 28. The annular lines of contact 28 on the bearing surfaces 24 of the ends of the magnets 16 are generally in
15 annular alignment with each other.

The beveled bearing surface 24 on the end of the magnet 16 is angled at a first acute angle A, relative to the wall of the support sleeve 12. The angled lip 26 on the mounting ring 22 is angled at a second acute angle B, relative to the wall of the support sleeve 12. The first acute angle A is greater than the second acute angle B, thereby
20 insuring that contact between the beveled bearing surface 24 and the angled lip 26 is only along a single annular line of contact 28. The difference in magnitude between acute angle A and acute angle B is preferably less than approximately 10 degrees, and preferably in the range of approximately two degrees to approximately four degrees. The first acute angle A, for example, can be approximately 45 degrees, while the second acute
25 angle B, for example, can be approximately 42 degrees.

If the magnet 16 contracts faster than the support sleeve 12, or if the support sleeve 12 expands faster than the magnet 16, the line of contact 28 will move downwardly along the beveled bearing surface 24 as the angled lip 26 straightens slightly. Conversely, if the magnet 16 expands faster than the support sleeve 12, or if the support
30 sleeve 12 contracts faster than the magnet 16, the line of contact 28 will move upwardly

along the beveled bearing surface 24, as the angled lip 26 flexes slightly further upwardly. In either case, secure contact is always maintained between the magnet 16 and the mounting ring 22.

5 It can be seen that, as differential thermal expansion takes place between the magnet 16 and the support sleeve 12, the line of contact 28 will move up or down along the beveled bearing surface 24, maintaining forcible contact at all times between the mounting ring 22 and the magnet 16. This continuous contact maintains an inward force at all times on the magnets 16, thereby always holding the magnets 16 securely in place longitudinally, without room for vibration.

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While the particular invention as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages hereinbefore stated, it is to be understood that this disclosure is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended other than as described
15 in the appended claims.